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(54) Disc brakes

(57) A disc brake includes a disc 11 which is mounted on axially extending dogs 13 on a rotatable member 12, the dogs 13 engaging notches 14 in the disc 11, so that the disc 11 is movable axially of the rotatable member 12 but is constrained to rotate therewith. Spring means 30, 42 are provided between the normally trailing radial faces of the dogs 13 and the opposed radial face of the associated notch 14, in order to take up clearance therebetween. In an alternative embodiment (Fig. 8) the dogs (116) carrying spring means 42 and wear plates 48 engage in notches (125) on the radially outer periphery of the brake disc (123), and two diametrically disposed brake calipers (130) are provided. A layer of heat insulating material is provided between the disc 11 and each spring element 30, and the disc brake may include two discs, each engaged in operation on opposed faces by respective brake pads.

FIG 3.

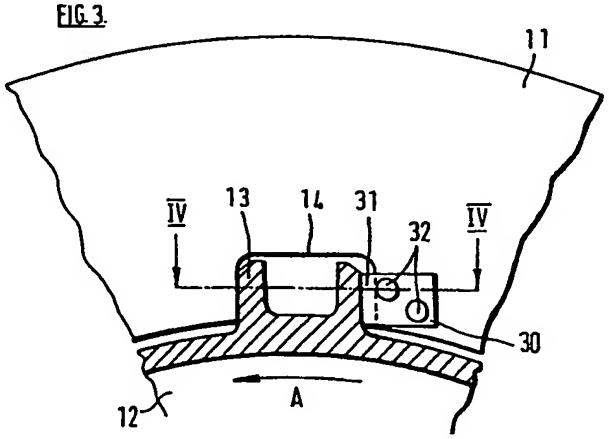

FIG 5.

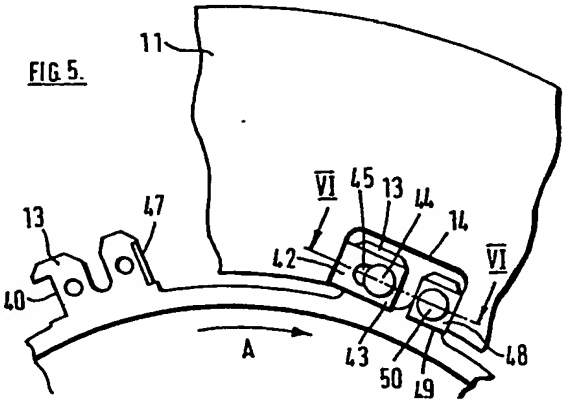

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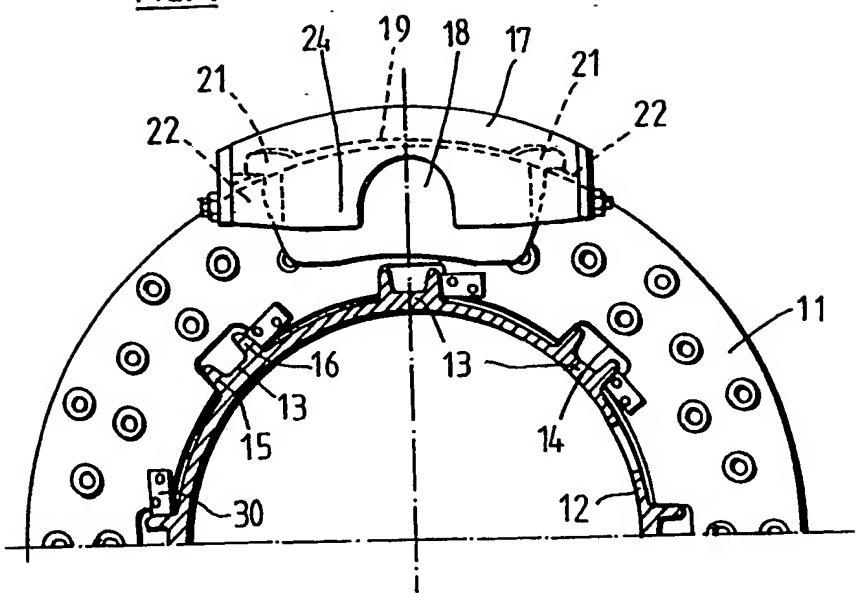
FIG. 1.



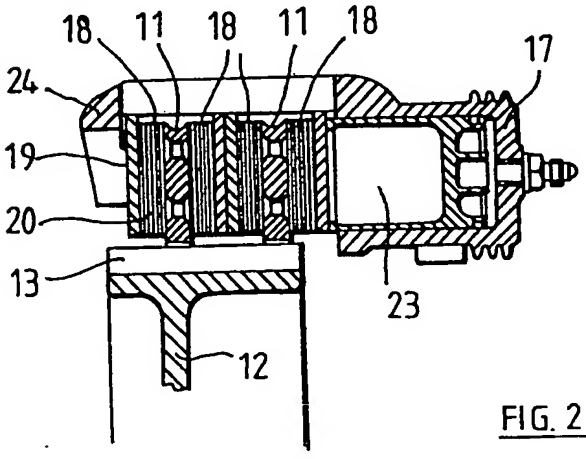


FIG. 2.

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FIG. 3.

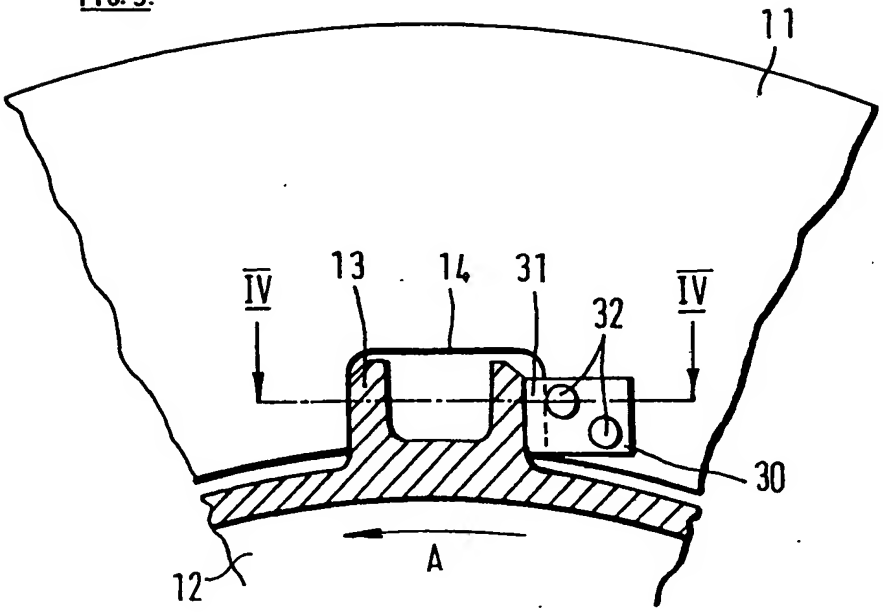

FIG. 7.

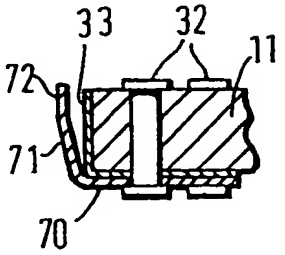

FIG. 4.

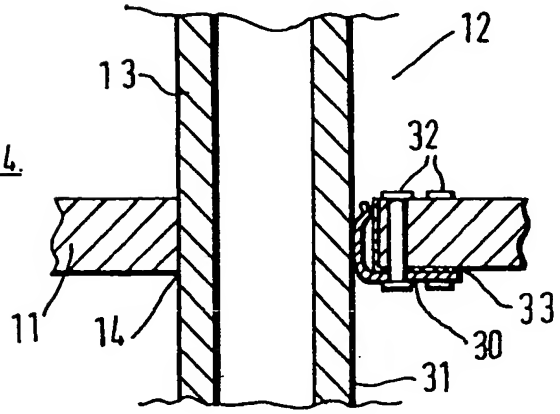

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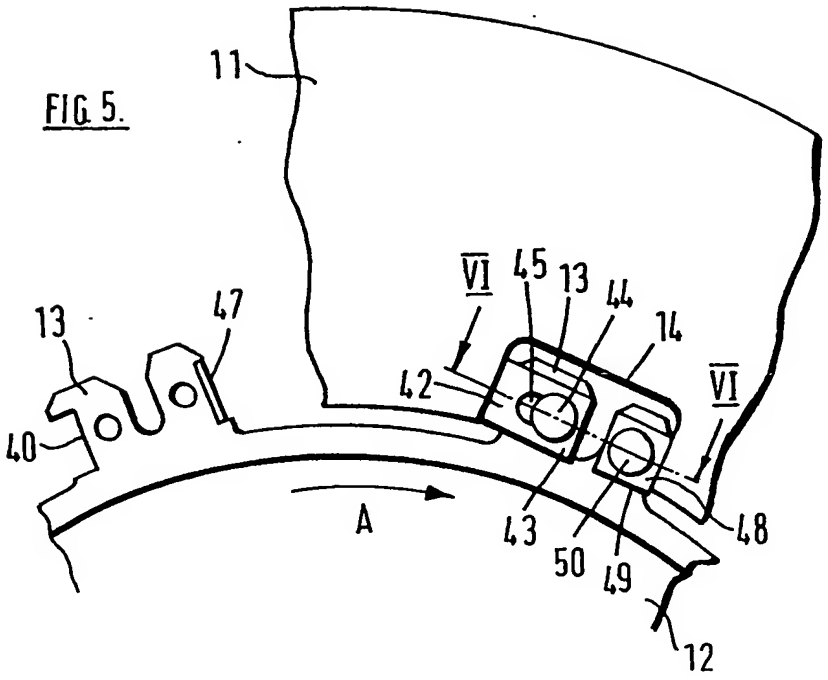
FIG. 5.



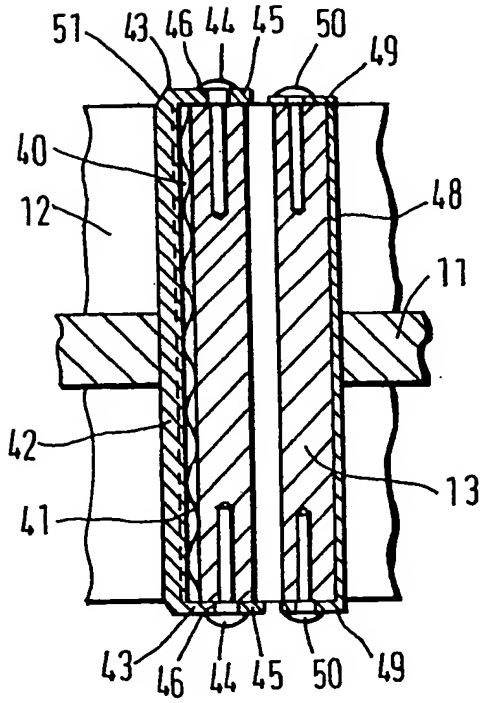


FIG. 6.

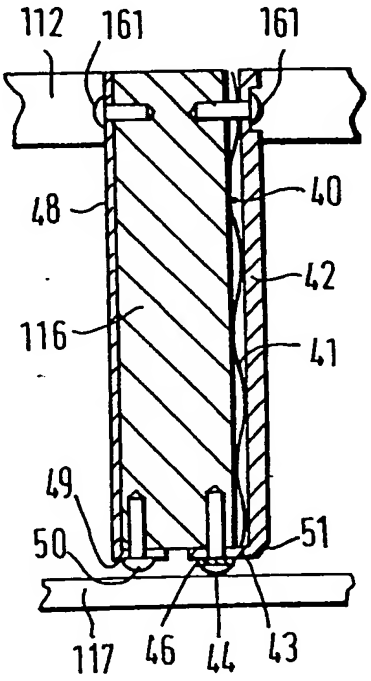


FIG. 12.

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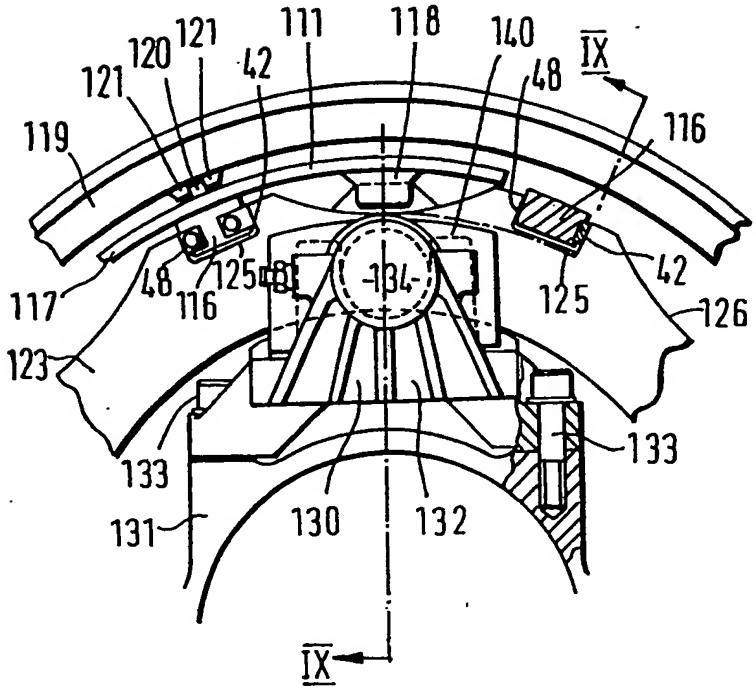


FIG.8.

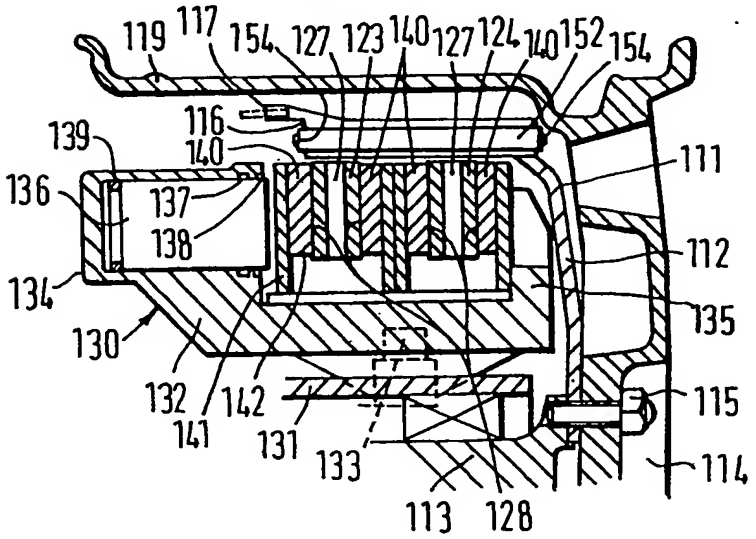
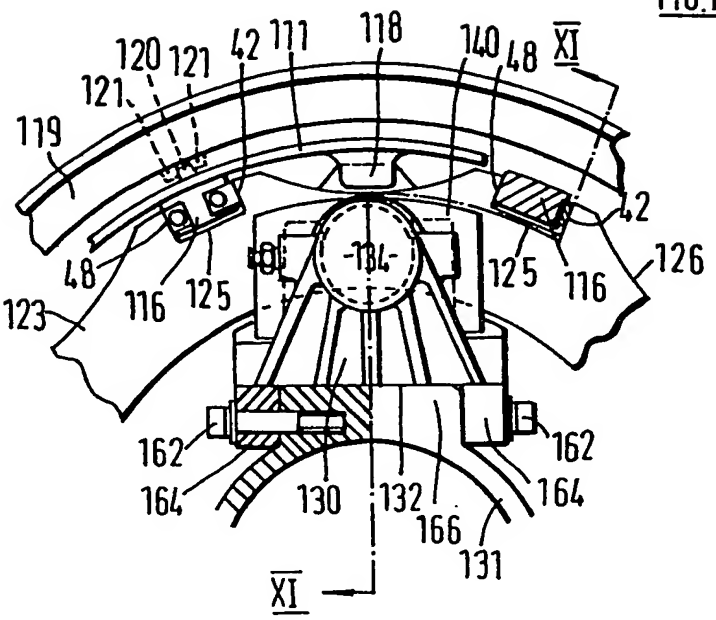


FIG.9.

FIG.10.


120
121
121
42
111
118
140
48
XI
119
42
48
116
125
134
125
116
126
123
162
164
130
132
166
131
162
164
XI

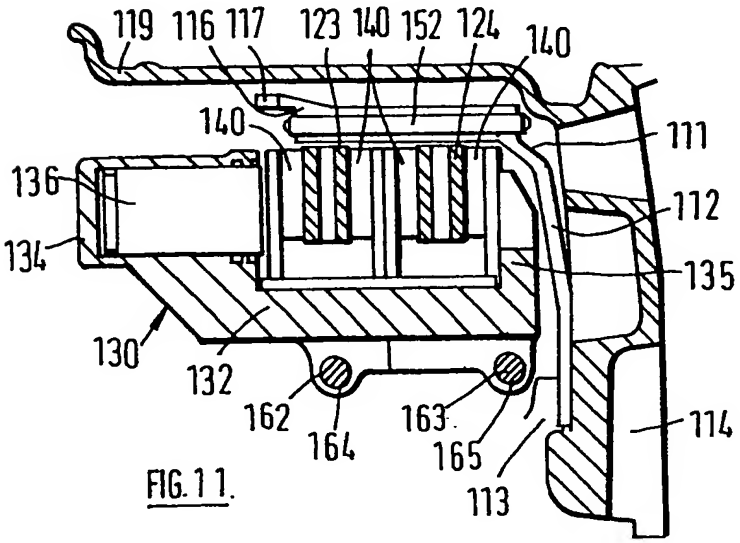

119
116
117
123
140
152
124
140
140
111
136
112
134
135
130
132
162
164
163
165
113
114

FIG.11.

SPECIFICATION

Disc brakes

The present invention relates to disc brakes.

It has been proposed to provide disc brakes in which a disc is mounted for rotation with a rotatable member but slidable axially thereof. A fixed caliper assembly straddles a portion of the periphery of the disc and supports brake pads on either side of the disc. The caliper includes a hydraulic cylinder actuator on one side of the disc, which upon brake application forces the pad on that side of the disc into engagement with the disc which is then moved axially into contact with the pad on the other side of the caliper. In some embodiments, a plurality of discs are mounted so that they are slidable axially of the rotatable member, the caliper supporting brake pads for action against each side of each disc.

With disc brakes of this type, the discs have peripheral notches which locate on axial ribs or dogs on the rotatable member. When the discs are made of metal, for example cast iron or steel, it is possible when a disc is used and is heated to the high temperatures that can be attained during braking that this will cause stress relief resulting in the notches shrinking, when the disc cools, to a size smaller than that to which the notches were initially formed when the disc was made. Thus there is a risk that the cooled disc will jam on the dogs. To avoid this the discs are made with enlarged notches which become even bigger due to thermal expansion when the disc is hot. Since it is not possible to predict the extent of notch shrinkage the notches are formed to ensure clearance between the notches and dogs when the disc becomes cold after braking, and that clearance increases by thermal expansion when the disc becomes heated. When the brake is not being applied the consequence of such clearance is that the disc will not be properly located on the dogs and may wobble about during rotation, which may cause "knock back" of the actuator piston to an undesired extent, as well as producing chattering and the possibility of damage to the dogs, disc or pads.

The present invention takes up some of the excess clearance when the disc is hot or cold, thus improving location of the disc on the dogs.

According to one aspect of the present invention a disc brak includ s at least one disc mounted with respect to a rotatable member for rotation therewith, said disc being slidable axially relative to the rotatable member, axially extending dogs being provided on the rotatable member for engagement of corresponding notches on a periphery of the disc with a ber in one direction, spring means being interposed between the normally trailing face of each dog and the opposed face of the corresponding notch, to take up the clearance therebetween.

Various embodiments of the invention are now described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a part sectional view of an embodiment of a disc brake formed according to the present invention;

Figure 2 shows a cross section along the line II–II in Fig. 1;

Figure 3 is an enlarged view of a section of the brake illustrated in Fig. 1;

Figure 4 is a section along the line IV–IV in Fig. 3;

Figure 5 is an enlarged view comparable to Fig. 3, of a section of another embodiment of a disc brake formed in accordance with the present invention;

Figure 6 is a section along the line VI–VI in Fig. 5;

Figure 7 is a fragment of a section of a disc used in a modification of the embodiment in Figs. 1 to 4;

Figure 8 shows a part sectional side elevation of an alternative disc brake formed in accordance with the present invention;

Figure 9 shows a section along the line IX–IX of Fig. 8;

Figure 10 shows a view similar to Fig. 8 illustrating a modification to the disc brake illustrated in Fig. 8;

Figure 11 shows a section along the line XI–XI of Fig. 10; and

Figure 12 shows a similar view to Fig. 6, illustrating an alternative method of securing the spring loaded and wear inserts.

As illustrated in Figs. 1 to 4 a disc brake comprises a pair of discs 11 mounted upon a hub or wheel bell 12. The discs 11 may be metal, for example cast iron or steel, or may be of another material, for example carbon. The wheel bell 12, which may be of steel or aluminium, is secured to a road wheel (not shown) of a vehicle, for rotation therewith. Wheel bell 12 is provided with a series of circumferentially spaced axially extending dogs 13 which engage in notches 14 in the inner periphery of the disc 11, so as to locate the disc 11 rotationally on the wheel bell 12 while permitting axial movement of the discs 11. A clearance is provided between the dogs 13 and the edg s of the disc 11 d fining the notches 14, in order to allow for expansion of the disc due to heating during braking. The dogs 13 are in the form of a pair of flange portions 15 and 16 with a recess therebetween, which permits air to circulate through the brake to assist cooling thereof.

11. The caliper assembly 17 supports four brake pads 18, a different one of said brake pads 18 adjacent each surface of the two discs 11. Each pad 18 comprises a backing plate 19 on one face of which is provided a pad of friction material 20. Each of the backing plates 19 is provided with a pair of lugs 21 which engage a pair of transverse formations 22 on the caliper assembly 17, thereby supporting the brake pads 18 so that they are free to slide parallel to the axis of rotation of the discs 11. A hydraulic cylinder/piston assembly 23 is provided on the caliper assembly and acts, when the brakes are applied, against the backing plate of the adjacent brake pad 18, to force it axially towards the discs 11 and other brake pads 18. Movement of the actuating piston causes the brake pads 18 and discs 11 to move axially, so that they are clamped between the piston and the opposite limb 24 of the caliper assembly 17, when a braking load will be applied to discs 11 and through the dogs 13 to the wheel bell 12 and road wheel of the vehicle.

As illustrated in Figs. 1, 3 and 4, spring elements 30 are provided on each disc 11, so that they will be interposed between the trailing radial face 31 of each of the dogs 13, relative to the direction of rotation A of the wheel bell 12 when the vehicle is travelling forwards, and the opposed radial face of the associated notch 14. Each spring element 30 is secured to the disc 11 by means of a pair of rivets 32 and a layer of heat insulative material 33 is interposed between the disc 11 and each spring element 30, in order to prevent damage to the spring element 30 by heat generated during braking. The insulating material 33 may be synthetic, for example an aramid material which may be KEVLAR (Trade Mark of Du Pont), and preferably is located at least under the rivetted portion of a siad spring element 30.

When the discs 11 are mounted on the wheel bell 12, the spring elements 30 will act against the opposed face 31 of the associated dog 13, thus forcing the leading face of the dog 13, which will take the braking torque when the vehicle is travelling in the forward direction, into engagement with the opposed face of the associated notch 14. The discs 11 will thus be accurately located on the wheel bell 12, while still having the necessary clearances to allow for shrinkage. Also as the leading faces of the dogs 13 ar held in engagement with the opposed faces of the notches 14, there will be no lag between application of the brake and retardation of the wheel.

In the alternative embodiment illustrated in Fig. 5 and 6, a recess 40 is provided in the flanges 43 at each end which abut the ends of the dog 13 and is located in the recess 40 by screws 44 which pass through holes 45 in the flanges 43. The holes 45 are elongated and spacing washers 46 are provided between the heads of the screws 44 and the ends of the dog 13, so that the strip 42 under the influence of the spring 41 will normally protrude from the recess 40, but may be depressed into the recess 40 against the load applied by the spring 41. The strip 42 may be made of titanium or some other heat insulative material which will protect the spring 41 against the heat generated during braking. A chamfered lead-in portion 51 is provided on the strip 42, to facilitate assembly of the discs 11 onto the wheel bell 12.

In the embodiment illustrated in Figs. 5 and 6, a shallow recess 47 is also provided in the leading face of each dog 13. Particularly in the case where the bell 12 is of aluminium a wear insert 48 is preferably located in the recess 47 so that it fills the recess and protrudes slightly from the face of the dog 13. The wear insert 48, which may be of metal for example steel, has a pair of flange portions 49 which are clamped to the ends of the dog 13 by means of screws 50. With this embodiment, when a disc 11 is mounted upon the wheel bell 12, the spring loaded strips 42 will engage the opposed faces of the correcponding notches 14 thereby forcing the wear inserts 48 into engagement with the opposed faces of the associated notches 14. Again, this will locate the disc 11 accurately on the wheel bell 12.

In the modification shown in Fig. 7 the spring 30 of Figs. 1 to 4 is replaced by a leaf spring 70 cranked to provide a cantilever arm 71 which can have a bent end portion 72 intended to be applied substantially flat against the face 31 of a dog 13 (Fig. 4).

In the disc brake illustrated in Figs. 8 and 9 a wheel bell 111 having a radially extending flange portion 112 which is adapted to be clamped between a wheel hub 113 and a wheel 114, by means of a plurality of angularly spaced wheel bolts 115.

A series of angularly spaced dogs 116 extend axially from the outer periphery of the flange portion 112, the ends of the dogs 116 remote from the flange 112 being interconnected by a continuous rim formation 117. Axially extending reinforcing ribs 118 are provided between the rim formation 117 and flange portion 112 intermediate of the dogs 116.

The dogs 116 are located adjacent to but spaced from the inner periphery of the wheel rim 119. A series of drive pins 120 located at angularly spaced locations about the rim for-

bly made of a material with poor heat conducting properties, such as titanium, in order to minimise transmission of heat to the wheel 114.

A pair of brake discs 123 and 124 are mounted coaxially within the bell 111, so that notches 125 on the outer periphery of the brake discs 123 and 124 engage the dogs 116 so that the discs 123 and 124 are slidable axially thereof. Portions 126 in the outer peripheries of the discs 123 and 124 between notches 125 are cut away to provide a clearance for the reinforcing ribs 118. The discs 123 and 124 are ventilated, having a series of radial passageways 127 running between the friction surfaces 128.

A pair of brake calipers 130 (only one shown) are mounted on the suspension upright 131 so that they straddle portions of the inner periphery of the brake discs 123 and 124 at diametrically opposed positions, for example at either end of a substantially horizontal diameter of the discs. Each caliper comprises a saddle formation 132 which is secured to the suspension upright 131 by means of a pair of bolts 133. The point of attachment of the saddle formation 132 is at or near the centre of braking torque so that the torsional loads on the saddle formation 132 during braking will be minimised. The centre of braking torque will however move towards the flange portion of the wheel bell 111, as the friction elements wear. In an alternative arrangement, as illustrated in Figs. 10 and 11, the saddle formation 132 is secured to the suspension upright at axially spaced locations 162 and 163, comprising a pair of bolts 162 and a pair of bolts 163 pinching faces of the caliper lugs 164 and 165 against faces of a boss 166 on the suspension upright 131.

The saddle formation 132 has a cylinder formation 134 at one end and a reaction plate formation 135 at the other, both the cylinder formation 134 and reaction plate formation 135 radially overlapping the brake discs 123 and 124.

An actuating piston 136 is provided in the bore of cylinder formation 134 for movement towards discs 123 and 124. The piston 136 is sealed in the bore of cylinder formation 134 by means of a pair of seals 137 and 138 adjacent the end of the bore. These seals 137 and 138 act to prevent dirt entering the bore of the cylinder formation 134 and also upon rollback serve to retract piston 136 when hydraulic pressure in the cylinder 134 is released. A further seal 139 is provided at the inner end of piston 136 to prevent leakage of hydraulic fluid and also keeps the hydraulic fluid well away from the heat generated during braking.

located between the brake discs 123 and 124 and between the brake discs 123 and 124 and the piston 136 and reaction plate 135 on the saddle portion 132 of caliper 130, such that each of the friction surfaces 128 of the discs 123 and 124 are swept by the pad 142 of one of the brake pads 140. The brake pads 140 are supported in the saddle portion 132, so that they are restrained from movement in the direction of rotation of the discs 123 and 124 but are free to slide parallel to the axis of rotation. Movement of the piston 136 towards the reaction plate formation 135, will thus cause the brake pads 140 to slide axially on the saddle portion 132 and the brake discs 123 and 124 to slide axially on the dogs 116, until the brake pads 140 and discs 123 and 124 are clamped between the piston 136 and the reaction plate formation 135, when a braking load will be applied to the discs 123 and 124 and this braking load will be transmitted through the dogs 116 to the wheel bell 111 and road wheel 114.

A spring loaded insert 42 is provided on the normally trailing face of each dog 116 and a wear insert 48 on the normally leading edge of each dog 116, in the manner described with reference to Figs. 5 and 6.

In the alternative embodiment illustrated in Fig. 12, the strips 42 and 48 are located at the inward edge of the dogs 116 by means of screws 161 which extend from the faces of the strips 42,48. The screw securing strip 42 locates the strip at its maximum extension from the rear face of recess 40, so that the strip is able to move into the recess 40 from that position. The screws 161 are located clear of the portions of the dogs which engage the discs 123 and 124.

CLAIMS

1. A disc brake including at least one disc mounted with respect to a rotatable member for rotation therewith, said disc being slidable axially relative to the rotatable member, axially extending dogs being provided on the rotatable member for engagement of corresponding notches on a periphery of the disc with a clearance therebetween, said dogs having a normally leading face and a normally trailing face relative to rotation of the rotatable member in one direction, spring means being interposed between the normally trailing face of each dog and the opposed face of the corresponding notch, to take up the clearance therebetween.

2. A disc brake according to claim 1 in which each spring element is mounted on the disc and arranged to overlie the trailing face of the associated notch in the periphery of the disc.

3. A disc brake according to claim 2 in

4. A disc brake according to claim 1 in which a spring element is provided on the trailing face of each dog.

5. A disc brake according to claim 4 in which a recess is provided in the trailing face of each dog, a strip being disposed in said recess, said strip being secured to the dog in a manner which will permit movement of the strip in the recess, circumferentially relative to the rotatable member, means being provided to bias the strip away from the dog.

6. A disc brake according to claim 5 in which the strip has a flange portion at each end, said flange portions abutting the ends of the dog, the strip being secured to the dog for circumferential movement relative to the hub, by fastening means passing through elongate holes in the flange portions.

7. A disc brake according to claim 5 or 6 in which a wavy leaf spring is located in the recess beneath the strip.

8. A disc brake according to any one of claims 5 to 7 in which the strip is provided with a chamfered lead-in portion to facilitate mounting of the disc onto the dog.

9. A disc brake according to any one of claims 5 to 8 in which he strip is made from heat insulative material.

10. A disc brake according to any one of the preceding claims in which the leading edge of each dog is provided with a wear insert.

11. A disc brake according to any one of the preceding claims in which a brake caliper is mounted on a non-rotatable member and straddles the periphery of the brake disc remote from the dogs, said brake caliper comprising a saddle portion having an actuating piston mounted on one side of the brake disc, and a reaction plate on the opposite side of the brake disc, said actuating piston and reaction plate radially overlapping the brake disc and a pair of brake pads slidingly located on the saddle portion, one on each side of the brake disc, so that movement of the actuating piston towards the reaction plate will move the pads and disc axially, to clamp them against the reaction plate and apply the brake.

12. A disc brake according to Claim 11 in which the caliper mounting point is at or near the centre of braking torque.

13. A disc brake according to Claim 12 in which the caliper is mounted at axially spaced locations, one location on each side of the centre of braking torque.

14. A disc brake according to any one of Claims 11 to 13 in which a pair of brake calipers are provided at diametrically opposed positions.

15. A disc brake according to any one of the preceding claims including a bell formation having a flange portion adapted to be secured periphery of the flange portion of the bell formation and are interconnected at the ends thereof remote from the flange portion, by a continuous rim formation.

17. A disc brake according to Claim 15 or 16 in which a plurality of angularly spaced drive pins are provided in the rim portion of the bell formation, these drive pins engaging corresponding formations on the rotatable member so that the braking load may be transmitted thereto.

18. A disc brake according to Claim 17 in which the drive pins are made from a heat insulative material.

19. A disc brake substantially as described herein with reference to and as shown in Figs. 1 to 12 of the accompanying drawings.

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